BRITISH STANDARD

BS 4484-1: 1969

Specification for

Measuring instruments for constructional works —

Part 1: Metric graduation and figuring of instruments for linear measurement

Confirmed January 2010

Co-operating organizations

The Committee responsible for the preparation of this British Standard consists of representatives from the following Government departments and scientific and industrial organizations:

Association of Consulting Engineers
Construction Industry Training Board
Drawing Office Material Manufacturers & Dealers Association
Federation of Civil Engineering Contractors
Federation of Hand Tool Manufacturers
Incorporated Association of Architects and Surveyors
Ministry of Housing and Local Government
Ministry of Public Building & Works
Ministry of Public Building & Works — Building Research Station
Modular Society
National Federation of Building Trades Employers
Royal Institute of British Architects
Royal Institution of Chartered Surveyors

This British Standard, having been approved by the Building Divisional Council, was published under the authority of the Executive Board on 31 July 1969

The following BSI references relate to the work on this standard:
Committee reference B/98
Draft for comment 67/33087

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Amendments issued since publication

Amd. No.	Date	Comments

Contents

Foreword

In order to keep abreast of progress in the industries concerned, British Standard are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the Committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 5 000, fully indexed and wit a note of the contents of each, will be found in the British Standards Yearbook, price 20s. The BS Yearbook may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standard: BS 3693. Recommendations for the design of scales and indexes.

The programme for the change to the metric system in the construction industry[1)] was published by the British Standards Institution in February 1967. That document required the early availability of metrically graduated measuring instruments. This standard has been produced to assist manufacturers in achieving this aim, and is issued under the authority of the Building Divisional Council.

The construction industry in the United Kingdom has decided not to use the centimetre, to accord with Draft ISO Recommendation No. 1557[2)], for the adoption of a rationalized system of metric units known as the Système International d'Unités (SI), in which the centimetre is a non-preferred sub-multiple. Some 25 countries, including the major European countries, have passed or are preparing legislation to make the SI the only legal system of measurement.

The instruments covered by the standard are, therefore, figured either in metres and decimal parts of a metre, or in millimetres, and this will be compatible with the manner in which dimensions appear on drawings, provided that such drawings have been prepared in accordance with the recommendation of BS 1192:1969 "Recommendations for building drawing practice".

There appears to be no immediate need, or demand, for radical changes in the materials, form of construction or the general quality of manufacture and accuracy of the instruments used in constructional site work. Such changes may even be undesirable during the period of gaining familiarity with metric units of measurement. The object of Part 1 of the standard is to ensure that, during this period, observational errors are minimized by ensuring that the graduation and figuring of instruments is in accordance with well-established ergonomic principles.

Whilst accuracy is not covered by Part 1 of the standard the choice of instrument for a particular task should always be determined by the degree of accuracy appropriate to that task. Part 2 of the standard will cover the performance standards, including accuracy, of all of the instruments for which the graduation and figuring requirements are given in Part 1. When Part 2 is published BS 4035[3)] will be withdrawn.

In the meantime, those engaged on work requiring precision should refer to BS 4035, the application of which will be included in a Code of Practice on accuracy in building (now in the course of preparation).

The instruments covered by the standard are those in common use in constructional site work, but it is hoped that the recommended principles of graduation and figuring will be adopted by other industries.

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1) PD 6030 "Programme for the change to the metric system in the construction industry".

2) Draft ISO Recommendation No. 1557 "Rules for the use of units of the international system of units and a selection of the decimal multiples and sub-multiples of the SI units".

3) BS 4035, "Linear measuring instruments for use in building and civil engineering constructional works. Steel measuring tapes, steel bands and retractable steel pocket rules".

During the transitional period it is considered important that metric and imperial units should not appear on the same instrument. Where instruments which are graduated and figured in accordance with this standard are used on construction sites it is strongly recommended that no other form of metrically graduated instrument be used on the same site.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 9 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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1 Scope

This British Standard specifies the requirements for the metric graduation and figuring of the following instruments:

1) Folding rules.

2) Laths.

3) Folding and multi-folding rods.

4) Graduated squares.

5) Retractable coated and plated steel pocket rules.

6) Coated steel tapes and etched steel tapes and bands.

7) Synthetic material tapes.

8) Studded steel band chains

9) Land chains.

10) Levelling staffs.

2 Definitions

For the purposes of this British Standard, the following definitions apply:

scale
an array of marks, together with any associated figuring, in relation to which the dimension of the measured object is directly observed

graduation mark
one of the marks constituting a scale

scale division
the part of the scale delimited by the centre lines of two adjacent graduation marks

graduation
the manner in which the graduation marks have been set out

figuring
a series of marked numerals on an instrument for linear measurement, which give the distance of a particular graduation mark from the zero point of the instrument

major graduation mark
graduation mark denoting one of the primary divisions into which the instrument is graduated

minor graduation mark
graduation mark denoting one of the smallest divisions into which the instrument is graduated

intermediate graduation marks
graduation marks of an order which falls between the major graduation and the minor graduation of an instrument

fine graduation
the smaller of two orders of scale division appearing on the same instrument

coarse graduation
the larger of two orders of scale division appearing on the same instrument

quick-reading figure
a repeating metre numeral, appearing in instruments over 1 m in length, at each 100 mm graduation mark, to enable the user to read instantaneously without needing to scan the instrument

zero point
the first extremity of the instrument from which all graduation and figuring is dimensioned

folding rule
a graduated and figured rule consisting of four equal lengths of boxwood, suitable metallic or synthetic material, connected by two hinges and a central joint

lath
a graduated and figured rule consisting of a straight continuous strip of boxwood, suitable metallic or synthetic material

folding and multi-folding rod
a graduated and figured rule consisting of two or more lengths of boxwood, suitable metallic or synthetic material, connected by positive folding joints

square
an “L” or “T” shaped instrument of boxwood, suitable metallic or synthetic material, used primarily for making right-angles, but sometimes graduated and figured to allow for linear measurement

retractable coated steel pocket rule
a steel blade with a coated finish marked with graduation and figuring, a blade tip, a return spring and enclosing case, so designed that the blade may be quickly and easily extended from the case and retracted

retractable plated steel pocket rule
an instrument similar to the retractable coated steel pocket rule, but with the graduation and figuring appearing on a plated background

coated steel tape
a steel ribbon with a coated finish marked with graduation and figuring, a winding drum, a winding handle and a case or reel. When in use the ribbon is not disconnected from the winding drum

etched steel tape
an instrument similar to a coated steel tape but with graduation and figuring etched into the metal

etched steel band
a steel ribbon, similar to an etched steel tape, but fitted at each end with a handle or ring. When not in use the instrument is wound on to a reel

synthetic material tape
a ribbon of suitable synthetic material marked with graduation and figuring, a winding drum, a winding handle and case or reel. When in use the ribbon is not disconnected from the winding drum

studded band chain
a steel ribbon wound on to a spindle contained within a suitable winder, and graduated by means of raised studs at given intervals

land chain
a chain consisting of straight links of tempered steel wire, connected by three oval rings and terminating with swivel handles. Measurement is denoted by red and yellow synthetic material tallies

levelling staff
a staff consisting of wood or suitable metallic or synthetic material, graduated for vertical measurement, and read with an optical instrument. It may also be used for tachymetric measurement

reading face
that area of the face of a levelling staff which remains visible between any framing or other obscuring portions of the staff

3 Description

3.1 Presentation

3.1.1 All instruments covered by this specification shall be clearly set out to allow for ease of reading with minimum observational error.

3.1.2 All markings, other than graduation marks and figuring, shall be so positioned and of such a size as not to interfere with the legibility of the instrument.

3.1.3 The graduation marks and figuring shall always be displayed against a visually contrasting background.

3.1.4 Consideration shall be given to achieving compatibility between the legibility of graduation marks and the size and form of the figuring, when related to the distance at which the instrument will normally be read. Reference should be made in this regard to BS 3693[4)].

3.1.5 In all instruments calibration shall commence from the first extremity of the instrument. Thus tips, rings, handles or base plates shall be included in the dimensioning of the instrument, and the zero point shall be located accordingly.

3.2 Graduation

3.2.1 The instruments shall be divided by graduation marks indicating metres and decimal parts of a metre, or millimetres.

Clauses **3.2.2** to **3.4** shall not apply to land chains, studded steel band chains or levelling staffs.

3.2.2 The length of graduation marks shall be to not more than four orders of magnitude. These shall be as follows:

On instruments graduated on one edge only, the length of graduation marks shall, so far as is practicable, be equal to:

1) the whole width of the instrument (first order of magnitude).

2) two-thirds of the width of the instrument (second order of magnitude).

3) one-half of the width of the instrument (third order of magnitude).

4) one-third of the width of the instrument (fourth order of magnitude).

On instruments which are graduated on both edges, the length of the graduation marks shall be in the same proportion as above, but related to half the width of the instrument.

3.2.3 No graduation mark should be less than 2 mm in length and all graduation marks of the same order of magnitude shall be of the same length.

3.2.4 The width of the graduation marks should generally be in accordance with BS 3693-1[5)], but in any case graduation marks having an interval of 1 mm should not be wider than 0·3 mm.

3.2.5 Where material different from that which forms the main part of the instrument would otherwise obscure the graduation and figuring of the instrument (e.g. brass tips or hinges on a boxwood rule) the graduation shall continue on that material.

3.3 Figuring

3.3.1 The figures used should be similar to those specified in BS 3693[5)]. Similar type faces, such as Granby Bold or Futura, shall be deemed to comply with this standard, provided:

1) the Figure 3 has a flat top and the 6 and 9 have open tails,

2) the width/height ratio is approximately 3 : 5, and

3) the stroke width/height ratio is between 1 : 7 and 1 : 8.

[4)] BS 3693, "Recommendations for the design of scales and indexes"

[5)] BS 3693, "Recommendations for the design of scales and indexes", Part 1, "Instruments of bold presentation and for rapid reading".

3.3.2 The height of the major figures shall be as large as can be accommodated without interference with the graduation marks. Where smaller figures on an instrument are desirable they shall be approximately in the proportion of 4/5 and 3/5 of the height of the major digit.

3.3.3 All figures of the same order of magnitude shall be of the same height, except where these are "split" to accommodate other markings (see **3.4**).

All figuring shall be read from left to right of the instrument.

3.4 Other markings. Other markings such as the length of the instrument and the tension and temperature for which it was calibrated (see **10.4**), the manufacturer's name, etc., shall be positioned within the first 400 mm in such a manner as to cause the least disruption to the general form of graduation and figuring. This may be achieved by "splitting" the figuring as illustrated in Figure 2. The length of the instrument may be marked within a "box" in a similar manner to that illustrated in Figure 2.

4 Folding rules

4.1 Length of instrument. Folding rules shall be 1 m long.

4.2 Form of graduation

4.2.1 One face of the rule shall be graduated, along the upper edge, with major graduation marks at 10 mm intervals, intermediate graduation marks at 5 mm intervals and minor graduation marks at 1 mm intervals (fine graduation).

4.2.2 The lower edge of that face shall be similarly graduated but with the omission of the 1 mm graduation marks (coarse graduation).

4.2.3 The reverse face of the rule shall be graduated exactly as above, but with the coarse graduation on the upper edge and the fine graduation on the lower edge.

4.3 Form of figuring

4.3.1 Each 100 mm graduation mark shall be figured with numerals denoting the appropriate 3-digit number, positioned centrally to the graduation mark.

4.3.2 Each intervening 10 mm graduation mark shall be figured with numerals from 10 to 90 inclusive, positioned centrally to the graduation mark.

4.4 Special requirements. The choice of edge for coarse and fine graduation shall be such that the fine graduations are protected when the instrument is closed (see Figure 1).

Folding rules graduated and figured in a manner similar to that illustrated in Figure 1 shall be deemed to satisfy the above requirements.

5 Laths

5.1 Length of instrument. Laths shall be 1 m, 1·5 m or 2 m long.

5.2 Form of graduation. The form of graduation shall be exactly as for folding rules.

5.3 Form of figuring. The first metre shall be figured exactly as for folding rules. When the length of the lath exceeds 1 m, the whole-metre position shall be marked with the figures "1 m", positioned centrally to the relevant graduation mark, in a colour which contrasts both with the standard figuring and with the background.The second metre shall be figured exactly as for the first metre, but with the inclusion of a small quick reading "1 m" in the same contrasting colour as that used at the whole-metre position, located immediately over the numerals at each 100 mm interval.

6 Folding and multi-folding rods

6.1 Length of instrument. Folding and multi-folding rods shall be 2 m long.

6.2 Form of graduation and figuring. The form of graduation shall be exactly as for folding rules, and the form of figuring as for the lath.

7 Graduated squares

7.1 Length of instrument. Graduated squares shall be 1 m, 1·5 m or 2 m long.

7.2 Form of graduation and figuring. The form of graduation shall be exactly as for folding rules, and the form of figuring as for the lath.

8 Retractable coated steel pocket rules

8.1 Length of instrument. Retractable coated steel pocket rules shall be 1 m, 2 m, 3 m or 5 m long.

8.2 Form of graduation. The instrument shall be graduated on the upper face only and this shall be exactly as defined for the folding rule. The choice of edge for coarse and fine graduation is optional.

8.3 Form of figuring. The first metre shall be figured exactly as for folding rules. The whole-metre positions shall be marked with the figures "1 m", "2 m", etc., as appropriate, positioned centrally to the relevant graduation mark, in a colour which contrasts both with the standard figuring and with the background. Subsequent metres shall be figured in a similar manner to the first metre, but shall include a small quick-reading "1 m", "2 m", etc., as appropriate, in the same contrasting colour as that used at the whole-metre positions, located centrally to and immediately over the numerals at each 100 mm interval.

Retractable coated steel pocket rules graduated and figured in a manner similar to that illustrated in Figure 2, shall be deemed to satisfy the above requirements.

9 Retractable plated steel pocket rules

9.1 Lengths and form of graduation and figuring. The lengths and form of graduation shall be exactly as for retractable coated steel pocket rules. The figuring shall also be similar except that the whole-metre and quick-reading figures need not be in a contrasting colour.

10 Coated steel tapes

10.1 Length of instrument. Coated steel tapes shall be 10 m, 20 m or 30 m long.

10.2 Form of graduation

10.2.1 The tape shall be graduated and figured on the upper face only and shall be divided into intervals of four orders of magnitude in accordance with **3.2.2**. Major graduation marks shall be at 100 mm intervals (first order), intermediate graduation marks at 10 mm intervals (second order) with the 50 mm central graduation mark "arrowed", and at 5 mm intervals (third order).

10.2.2 The first and last metre of the tape shall be further subdivided into minor graduation marks at 1 mm intervals (fourth order).

10.2.3 The choice of edge used for graduation is optional.

10.3 Form of figuring

10.3.1 The tape shall be figured at the major graduation marks only.

10.3.2 The whole-metre positions shall be marked with the figures "1 m", "2 m", etc., as appropriate, positioned centrally to the graduation mark, in a colour which contrasts both with that used for the decimal fraction numerals and with the background.

10.3.3 At all other major graduation positions the metre numeral, which shall be smaller than the whole-metre numeral, together with the decimal point (positioned on the median) shall be located to the left of the graduation mark. The numeral and the decimal point shall be in the same colour as that used for the whole-metre figuring. The decimal fraction shall appear as a single digit, of the same size as, but in a contrasting colour to, the whole-metre numeral, immediately to the right of the relevant graduation mark.

10.4 Special requirements. Within the first 300 mm there shall be given an indication of the tension to be used, when the tape is supported throughout its length, and the temperature for which it was graduated. Tension is normally measured in newtons, but, as spring balances are normally used for checking the tension, the figure may be given in kilogrammes.

Coated steel tapes graduated and figured in a manner similar to that illustrated in Figure 3 shall be deemed to satisfy the above requirements.

11 Etched steel tapes and bands

11.1 Lengths, form of graduation and figuring and special requirements

11.1.1 Etched steel tapes shall be 10 m, 20 m or 30 m long. Etched steel bands shall be 30 m or 50 m long.

11.1.2 The form of graduation and figuring of etched steel tapes and bands shall be exactly as specified for coated steel tapes, except that a contrasting colour shall not be used. In lieu of this the whole-metre figuring is to appear in a "block" positioned centrally across the graduation mark (see Figure 3).

11.1.3 The operating tension and temperature shall be marked in a manner similar to the special requirements for coated steel tapes and bands (see **10.4**).

12 Synthetic material tapes

12.1 Length of instrument. Synthetic material tapes shall be 10 m, 20 m or 30 m long.

12.2 Form of graduation

12.2.1 The tapes shall be graduated with major graduation marks at 100 mm intervals, intermediate graduation marks, which shall be "arrowed", at 50 mm intervals and minor graduation marks at 10 mm intervals. The first and last metre shall *not* be further subdivided into millimetres.

The choice of edge to be graduated is optional.

12.3 Form of figuring

12.3.1 The form of figuring shall be exactly as for coated steel tapes (see **10.3**).

12.4 Special requirements. The operating tension shall be marked in a similar manner to the special requirements for coated steel tapes and bands (see **10.4**).

Synthetic material tapes graduated and figured in a manner similar to that illustrated in Figure 4 shall be deemed to satisfy the above requirements.

13 Studded steel band chains

13.1 Length of instrument. Studded steel band chains shall be 20 m long.

13.2 Width of instrument. Studded steel band chains shall be not less than 16 mm wide.

13.3 Form of division. The band chain shall be marked at the 5 m and 10 m positions by numbered brass plates approximately 23 mm × 16 mm in size. Smaller (12 mm × 6 mm) brass plates shall be positioned at each whole-metre position.

13.3.2 Each intermediate 200 mm position shall be located by raised brass studs.

13.3.3 The first and last metre shall be further divided into 10 mm subdivisions by smaller brass studs, the half-metre stud being accented by the inclusion of a small washer or by other similar means of identification.

13.3.4 All division markers shall appear on both faces of the band chain.

13.3.5 The band chain shall be set out to include the linear dimension to the extremity of the handle in the overall graduation (see **3.1.5**).

14 Land chains

14.1 Length of instrument. Land chains shall be 20 m long.

14.2 Form of division. The land chain shall be made up of links which, from centre to centre of each middle connecting ring, shall measure 200 mm. The first and last link shall be such that the linear dimension from the extremity of the handle to the centre of the middle connecting ring is also 200 mm (see **3.1.5**).

14.3 Tally markers. Tally markers of suitable synthetic material shall be attached to the middle connecting ring at every whole-metre position. Those marking each 5 m position shall be red, with raised numerals, the remainder shall be yellow, and should differ in shape. They should not, however, be marked.

15 Levelling staffs

15.1 Length of instrument. Levelling staffs shall be 3 m, 4 m, or 5 m long.

15.2 Width of reading face. The reading face shall be not less than 38 mm wide.

15.3 Form of graduation

15.3.1 All graduation marks shall have a vertical dimension of 10 mm and the space between graduation marks shall also be 10 mm. No graduation mark shall be less than 10 mm in its horizontal dimension.

15.3.2 Each set of five graduation marks, collectively denoting each 100 mm interval of the staff, shall be offset by approximately 2 mm, alternately to the left and to the right of the vertical central line of the reading face.

15.3.3 The outside edges of the lower three graduation marks, in each 100 mm interval, shall be connected by a vertical band, 5 mm wide, forming a natural or reversed "E" form, the upper and lower edges of which locate the 50 mm and 100 mm intervals respectively (see Figure 5*b*).

15.3.4 The other two graduation marks, in each 100 mm interval, shall be set off from the same internal vertical datum line as the "E" form (see Figure 5*b*).

15.3.5 Different colours (e.g. red and black on a white background, in which case the first metre should be black) shall be used for the graduation marks in alternate metres.

15.4 Shape of numerals

15.4.1 The limitations imposed by the necessity to incorporate vertical figuring within the confines of a relatively narrow reading face will result in numerals which cannot comply with BS 3693[6)]. The figuring, however, must be designed to obtain the maximum use of the available space, without detracting from the legibility of the graduation marks. Special attention shall be paid to the design of similar-shaped figures, with the 3's being flat topped, and the 6's and 9's having open tails. The numeral 9 shall be "blind" (see Figure 5*a*). Maximum differential shall be given to the numerals 2 and 7; and 5 and 3. The maximum distance at which the figures can be clearly and accurately read, through an optical instrument, shall be approximately equal to the distance at which the graduation marks can be similarly discerned.

[6)] BS 3693, "Recommendations for the design of scales and indexes".

On staffs where the reading face is 55 mm wide, figures whose size and shape are similar to those illustrated in Figure 5*a* shall be deemed to satisfy the above requirements. The size and shape of figures on staffs where the reading face is greater or less than 55 mm shall be increased or decreased proportionately.

15.5 Form of figuring

15.5.1 The staff shall be figured at every 100 mm interval with figures denoting the relevant metre, the decimal point and the first decimal part of a metre. These figures shall be located with their lower extremity co-incident with the bottom edge of the first graduation mark in each 100 mm interval. The co-incidental plane is, therefore, that to which the figures relate (see Figure 5*b*).

15.5.2 The metre numerals shall be smaller than the numerals denoting the decimal fraction and shall be in the ratio of 3 : 4. The decimal point shall be shown but may be located in the most convenient position between the two numerals (see Figure 5*b*).

15.5.3 Figuring shall be upright on the staff. Inverted numerals shall *not* be deemed to satisfy the requirements of this standard.

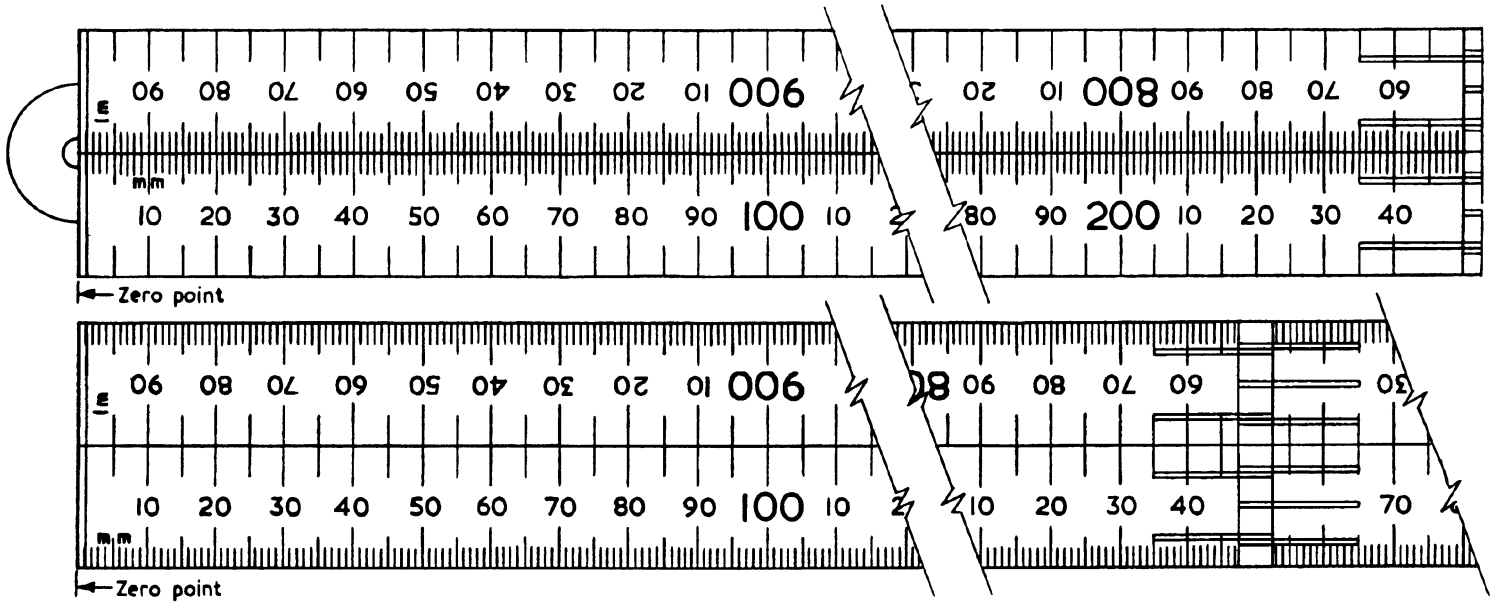

Figure 1 — Folding rule. (Upper illustration — fully folded; lower illustration — half open)

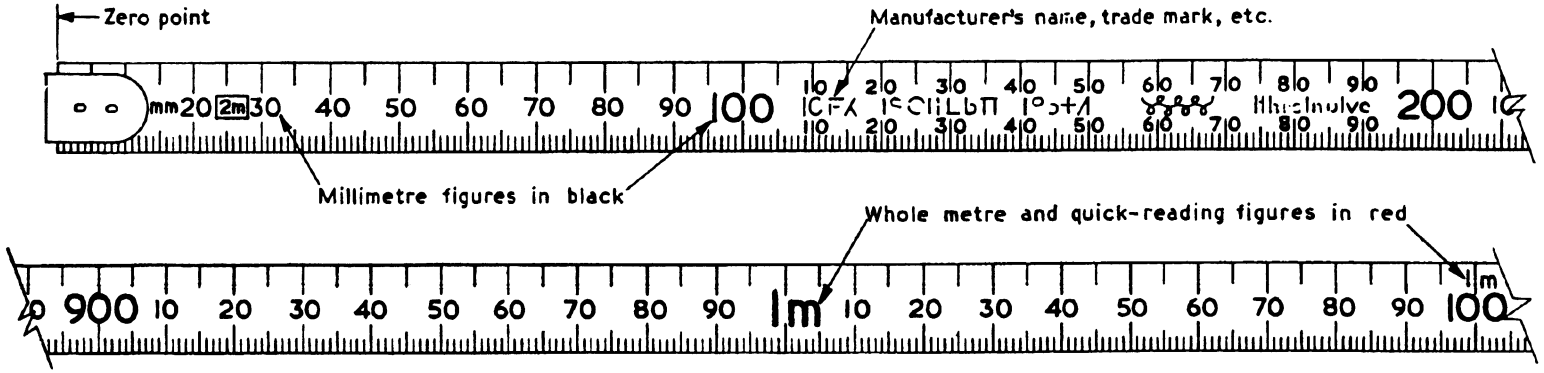

Figure 2 — Retractable steel pocket rule

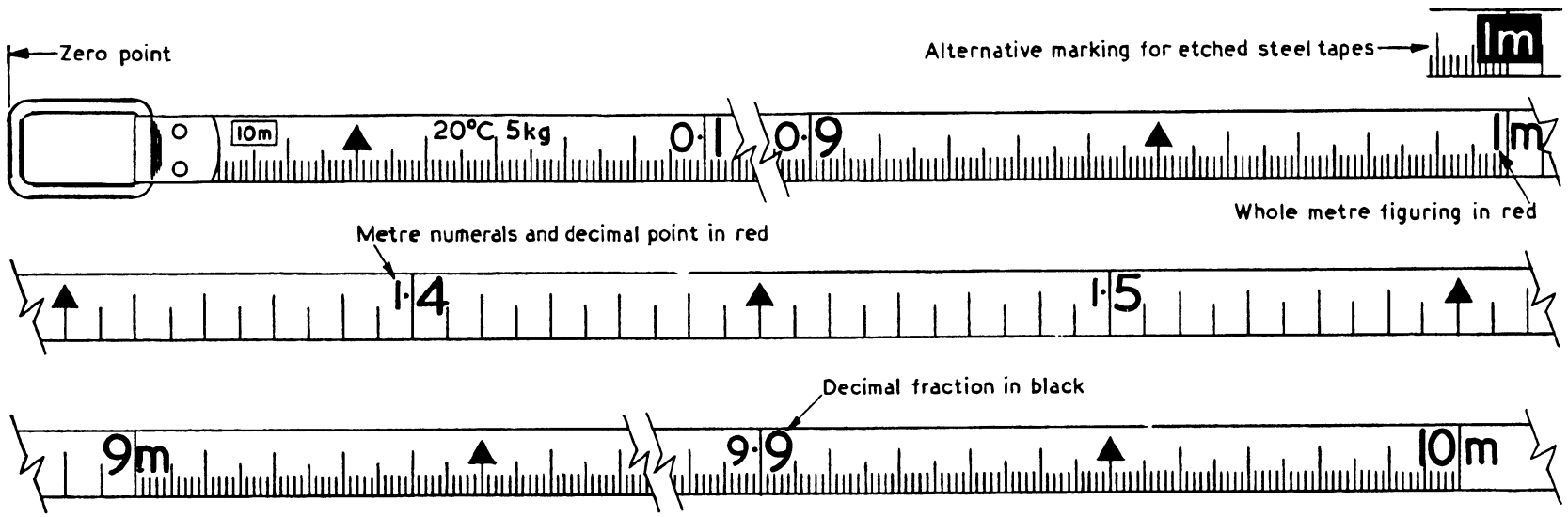

Figure 3 — Steel tapes

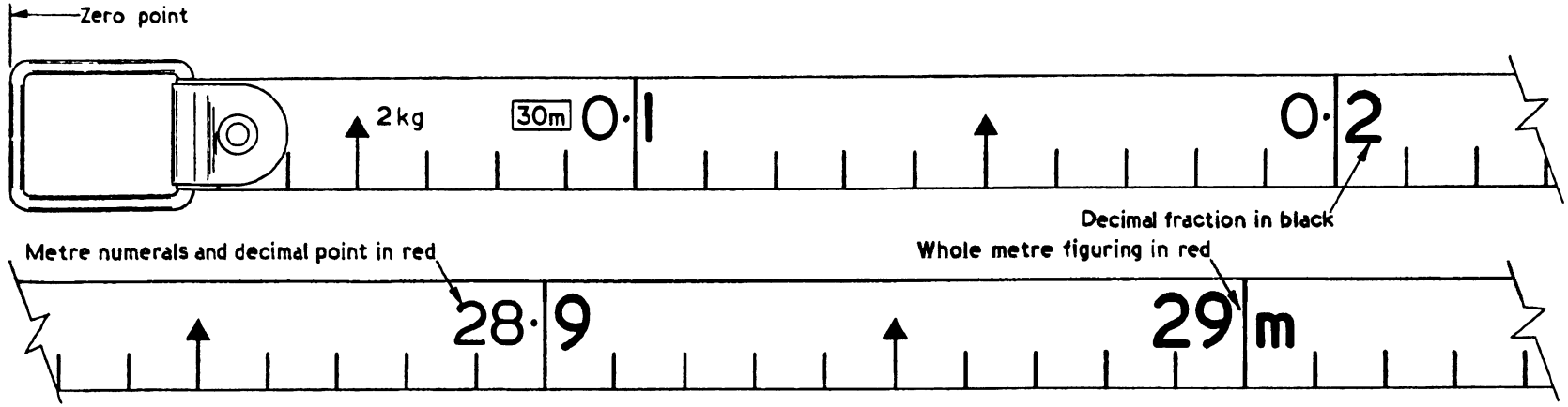

Figure 4 — Synthetic material tape

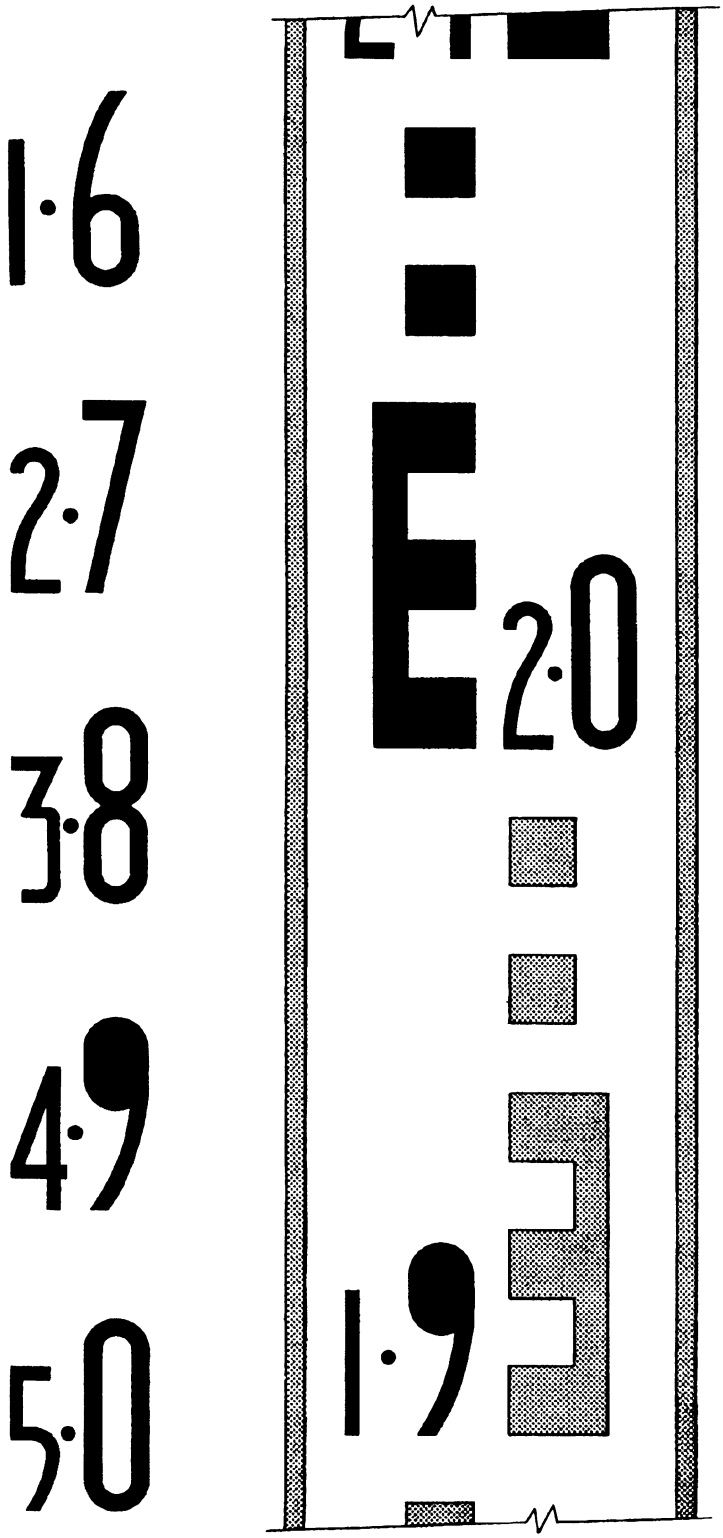

Fig. 5*a*.
Size and shape of numerals for a staff with a reading face width of 55 mm

Fig. 5*b*
Sample portion of staff with a reading face width of 55 mm (Full size)

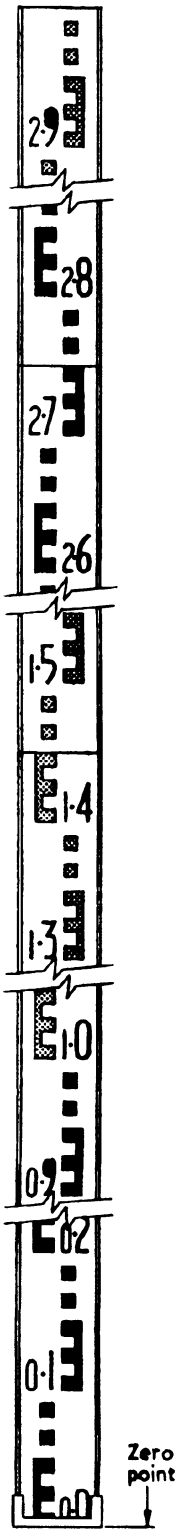

Fig. 5*c*
Illustration of a 4 m staff

Figure 5 — The metric levelling staff

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